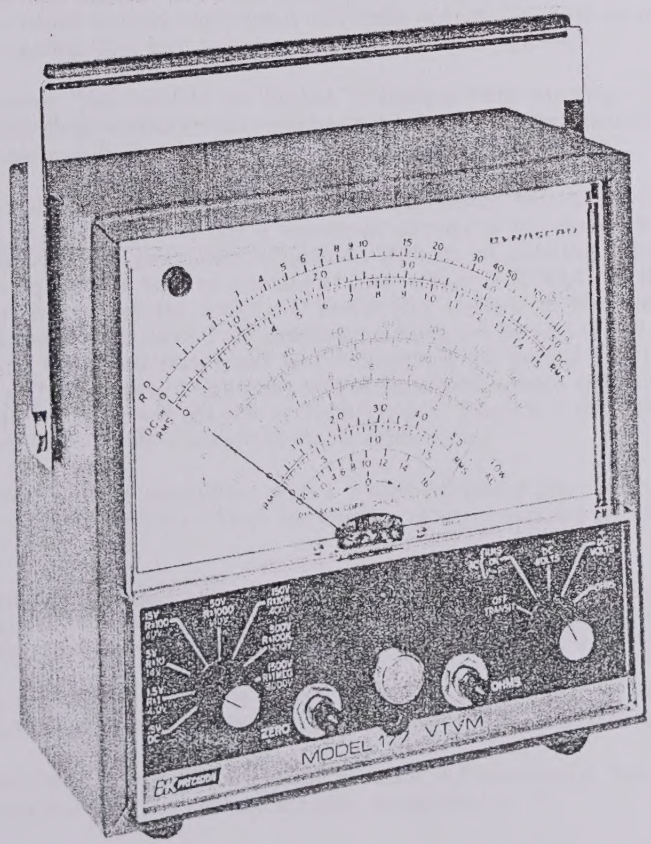
INSTRUCTION MANUAL

B+K PRECISION 177/V-95

ROCKFORD INSTRUMENT LAB
1718 Broadway
Rockford, IL 61104

VACUUM TUBE VOLTMETER



B+K PRECISION DYNASCAN CORPORATION

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TEST INSTRUMENT SAFETY

WARNING

Normal use of test equipment exposes you to a certain amount of danger from electrical shock because testing must often be performed where exposed voltage is present. An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Higher voltages pose an even greater threat because such voltage can more easily produce a lethal current. However, voltage as low as 35 volts DC or AC RMS should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Your normal work habits should include all accepted practices that will prevent contact with exposed high voltage, and that will steer current away from your heart in case of accidental contact with a high voltage. You will significantly reduce the risk factor if you know and observe the following safety precautions:

1. Don't expose high voltage needlessly. Remove housings and covers only when necessary. Turn off equipment while making test connections in high-voltage circuits. Discharge high-voltage capacitors after removing power.

2. Use an insulated floor material or a large, insulated floor mat to stand on, and an insulated work surface on which to place equipment; and make certain such surfaces are not damp or wet. Where insulated floor surface is not available, wear heavy gloves.

3. Use the time-proven "one hand in the pocket" technique while handling an instrument probe. Be particularly careful to avoid contacting a nearby metal object that could provide a good ground return path.

4. Always use an isolation transformer to power transformerless "hot chassis" equipment, where one side of the AC power line is connected directly to the chassis. This includes most recent television sets and audio equipment. Without an isolation transformer, the chassis of such equipment may be floating at line voltage (120 VAC, 60 Hz in USA), depending upon which way the 2-wire AC power plug is inserted. Not only does this present a dangerous shock hazard if the chassis is touched, but damage to test instruments or the equipment under test may result from connecting the ground lead to some test instruments to a "hot" chassis. The ground lead of most oscilloscopes and most other test instruments with 3-wire power plugs is at earth ground. The B & K-PRECISION Model TR-110 Isolation Transformer is suitable for most applications.

5. On test instruments or any equipment with a 3-wire AC power plug, use only a 3-wire outlet. This is a safety feature to keep the housing or other exposed elements at earth ground.

6. If possible, familiarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.

7. Also remember that AC line voltage is present on some power input circuit points such as on-off switches, fuses, power transformers, etc., even when the equipment is turned off.

8. Never work alone. Someone should be nearby to render aid if necessary. Training on CPR (cardio-pulmonary resuscitation) first aid is highly recommended.

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KEY FEATURES

1. Wide vision 6" x 4" meter scale for effortless reading.

2. Anti-parallax mirror permits maximum scale-reading accuracy.

3. Input impedance of 11 megohms on all D.C. voltage ranges. This is a very important feature when measuring oscillator grid-bias, AGC/AVC voltage in high impedance circuitry.

4. Special 0-.5 volt D.C. range, useful for accurate measurements of critical circuit parameters in solid state circuitry.

5. Measures D.C. voltage up to 1500 volts.

6. Measures A.C. RMS voltage up to 1500 volts.

7. Measures A.C. peak-to-peak, sine and complex voltages up to 4000 volts.

8. Measures resistances up to 1000 megohms.

9. Calibrated DB scale.

10. Zero center on meter scale, useful for F.M. discriminator alignment.

11. "Transit" switch position automatically clamps and protects meter movement.

SPECIFICATIONS

DC VOLTMETER, ELECTRONIC:

8 Ranges	0-.5, 1.5, 5, 15, 50, 150, 500, 1500 volts full scale.
Input Resistance	11 Megohms (1 Megohm in probe).
Sensitivity	7⅓ Megohms per-volt on 1.5 volt range.
Circuit	Balanced bridge using twin triode.
Accuracy	±3% full scale.

AC VOLTMETER, ELECTRONIC:

7 Ranges (R.M.S.)	0-1.5, 5, 15, 50, 150, 500, 1500 volts full scale.
7 Ranges (Peak-to-peak)	0-4, 14, 40, 140, 400, 1400, 4000 volts.
Frequency Response (5V Range)	±1 db 40 Hz to 4 MHz (600 ohms source).
Accuracy	±5% full scale.
DB Scale	—6 to +16db, +4 to +26db, +14 to +36db, +24 to +46db, +34 to +56db, +44 to +66db (0.775 volts into 600 ohm line on 0-5 volts AC scale = 0db).

OHMMETER, ELECTRONIC:

7 Ranges	0-1000 (x1), 10,000 (x10), 100,000 (x100), 1 meg (x1000), 10 meg (x10K), 100 meg (x100K), 1000 meg (x1 meg). 10 ohms center scale on Rx1.
	No battery required for ohmmeter.
METER	100 μA movement, plastic case. Anti-parallax mirror.
MULTIPLIERS	1% precision type.
TUBE	12AU7, twin triode bridge.
POWER REQUIREMENTS	105-125 volts 50-60 cycle AC.

OPERATING WARNINGS

1. When this VTVM is used to make measurements in equipment that contains high voltage, there is always a certain amount of danger from electric shock. The person using the VTVM should be a qualified electronics technician or otherwise trained and qualified to work in such conditions. Observe the "Test Instrument Safety" recommendations listed on the inside front cover of this manual.

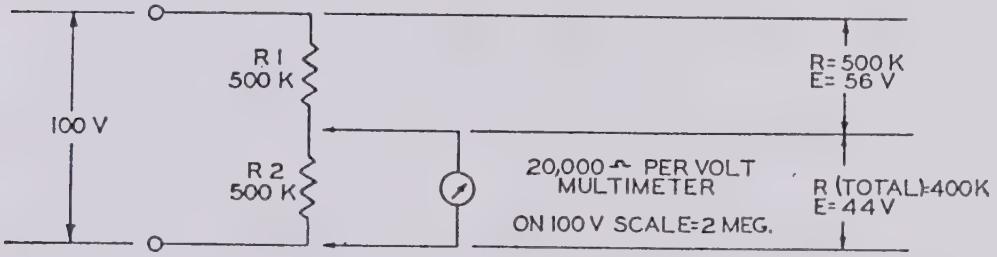
2. *There can be a shock hazard from touching the case of the VTVM when the common or ground lead of the meter is connected to a high voltage point.* The chassis and case of the VTVM are isolated from earth ground to permit you to "float" the meter for measuring voltage between two points, neither of which is grounded. However, this must be done with caution. The *common or ground lead* of the meter *is connected to the chassis and case* of the VTVM *and should normally be connected to a grounded point* in the equipment under test. If the common lead is connected to a high voltage point, the case of the VTVM rises to that potential. The meter case should be insulated from ground and the case should not be touched while connected in this manner. *Observe Caution.*

3. One of the most commonly encountered shock hazards is testing of "hot chassis" transformerless ac-powered equipment (see item 4 on the inside front cover of this manual for a full explanation of the hazard). If the common lead of the VTVM is connected to a "hot" chassis, the case of the VTVM will also become "hot." For safety, always use an isolated transformer between the ac power line and any "hot chassis" equipment under test. To be on the safe side, treat any ac-powered equipment as "hot chassis" unless you are sure it has an isolated chassis or earth ground chassis.

4. When handling the test probe, touch only the insulated portion. Never touch the exposed tip portion.

ADVANTAGES OF THE VTVM

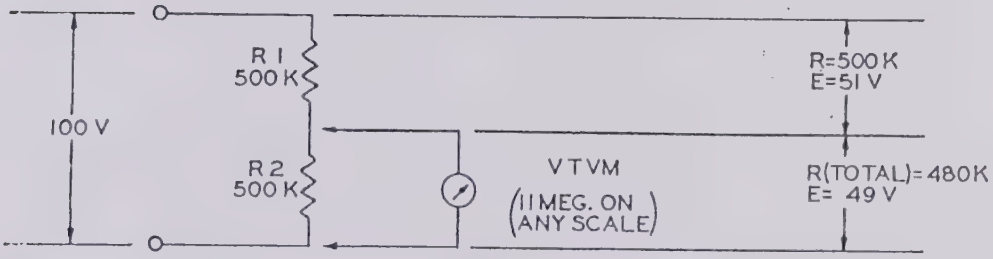
The greatest of the many advantages offered by the VTVM is its high input impedance. This feature makes possible the measurement of voltages in high impedance circuits such as oscillator grid circuits and AGC networks with a much higher degree of accuracy. As a simple illustrative example of this, we have shown in Figure 1A two 500K resistors connected in series across a 100 volt source of voltage. A simple knowledge of basic fundamentals makes it obvious here that the voltage drop across each resistor will be 50 volts. Measuring the voltage across either resistor with a 20K ohm-per-volt non-electronic type instrument on the 0-100 volt scale however, we obtain a reading of only 44 volts. Why the discrepancy. As shown in Figure 1A the meter (on the 100 volt range) can be considered a resistor of 2 meg., which is connected in parallel with the 500K resistor. A simple Ohm's Law calculation will readily show the total resistance of the parallel circuit to be 400K, resulting in a redistribution of the voltage drops in the circuit. Now the first 500K resistor has approximately 56 volts across it, and



$$R(\text{TOTAL})\ (\text{METER IN PARALLEL WITH R2}) = \frac{500\text{K} \times 2\ \text{MEG.}}{500\text{K} + 2\ \text{MEG.}} = 400\ \text{K}$$

$$\text{VOLTAGE ACROSS R2 AND METER} = \frac{400}{500+400} \times 100 = 44\ \text{VOLTS (APPROX.)}$$

FIGURE 1A



$$R(\text{TOTAL})\ (\text{METER IN PARALLEL WITH R2}) = \frac{.5\ \text{MEG.} \times 11\ \text{MEG.}}{.5\ \text{MEG.} + 11\ \text{MEG.}} = .48\ \text{MEG.} = 480\ \text{K}$$

$$\text{VOLTAGE ACROSS R2 AND METER} = \frac{480}{500+480} \times 100 = 49\ \text{VOLTS}$$

FIGURE 1B

the other 500K resistor in parallel with the meter has approximately 44 volts across it. The low resistance meter is loading or changing the impedance of the circuit when it is connected. When a VTVM is used as shown in Figure 1B we have a total of 11 megohms connected in parallel with the 500K resistor, and the total resistance of our parallel network is now approximately 480K, resulting in the voltage across the meter and resistor dropping only to 49 volts or a mere 2% lower than the actual operating voltage. More accurate readings can only be obtained with a high-impedance instument such as the VTVM.

Additional advantages of the VTVM in solid state measurements are:

A ½ volt full scale sensitivity range which permits the accurate reading of the fractions of a volt, (which are often applied between base and emitter of transistor devices). The VTVM input impedance is important, so that the connecting of the meter does not cause false readings due to current injection in the transistor base. Other advantages in the high impedance characteristics of the VTVM include the ability to accurately measure voltages, without upsetting circuit operation, on AGC lines, high impedance oscillator grid and other grid circuits, insulation resistance measurements.

ACCESSORIES

(Available on separate order)

RF PROBES. These probes contain a diode which is used as a half-wave rectifier. The half-wave rectifier circuit develops a dc voltage proportional to the peak value of a sine wave rf signal. Permits measurement of rf signals from 15 kHz to 250 MHz (-6 dB). Input impedance is 30 kΩ shunted by 45 pF, and internal shielding prevents stray rf pickup. Model AV-1A provides positive polarity output, Model PR-151 provides negative polarity output.

MODEL AV-2B HIGH VOLTAGE MULTIPLIER PROBE. This probe extends the maximum measurable voltage to 40,000 volts dc or 20,000 volts ac (at 60 Hz). 1000:1 voltage divider lets meter reading in volts equal the measured circuit voltage in kV (15.7 volts on meter equals 15,700 volts). 600 megohm input impedance prevents circuit loading of high impedance voltage sources. One useful application is the measurement of anode voltage of a CRT. The shape of the handle and the long probe tip keep you a safe distance from high voltage up to 40,000 volts.

MODEL CC-44 CONNECTING CABLE. Microphone connector on one end mates with meter, BNC, connector on other end mates with many instruments.

MODEL PR-43 AC/DC/OHMS PROBE. Replacement for probe supplied with this instrument.

DC VOLTAGE MEASUREMENTS

To measure DC voltages with the VTVM, **connect the common lead to the common B—, or "ground" side of the voltage to be measured.**[1] This is the chassis in most instances although in many transformerless sets, the chassis is isolated from the electrical circuitry and the common or B— side must be determined from the schematic diagram. Set the function switch to —DC or +DC as required, and set the range switch to a range greater than the voltage to be measured, if known. If not known, set to the highest, (0-1500 volt) range. Set the AC-OHMS, DC switch on the test probe to the DC position, then touch the probe to the voltage point to be measured. If the reading obtained is less than ⅓ full scale (500 volts when on the 0-1500 volt range) move the range switch to the next lower position. (0-500 volt range in this example.) For greatest accuracy, always select the range which permits you to obtain a reading nearest full scale deflection without having the pointer go off scale. *Use only the scales marked DC-RMS for reading DC voltages.* Use the 0-5 scale for reading DC voltages between 0 and .5 volts.

You will notice that your VTVM has a convenient center scale zero position for special applications such as balancing FM discriminator circuits. You may use this center scale zero feature when the range switch is on either the +DC or —DC position by simply adjusting the ZERO ADJ. control to bring the pointer to the center scale marking.

Set Function Switch to "—DC or +DC" volts position, and switch in the probe to "DC".

VOLTAGE TO BE MEASURED	SET RANGE SWITCH TO	READ FROM SCALE	MULTIPLY READING BY
0 to .5V	.5V DC	0 to 5	.1
0 to 1.5V	1.5V	0 to 1.5	1
1.5 to 5V	5V	0 to 5	1
5 to 15V	15V	0 to 1.5	10
15 to 50V	50V	0 to 5	10
50 to 150V	150V	0 to 1.5	100
150to 500V	500V	0 to 5	100
500 to 1500V	1500V	0 to 1.5	1000

AC VOLTAGE MEASUREMENTS

To measure AC voltages with the VTVM, **connect the common lead to one side of the voltage to be measured,**[1] set the function switch to AC, and the range switch to a range greater than the voltage to be measured, if known. If not known, set to the highest (0-1500 volt) range. Set the AC-OHMS, DC switch on the test probe to the "AC-OHMS" position, then touch the probe to the other side of the voltage to be measured. If the reading obtained is less than ⅓ full scale (500 volts when on the 0-1500 volt range) move the range switch to the next

[1]See OPERATING WARNINGS on page 3 concerning connection of common lead of VTVM.

lower position. (0-500 volt range in this example.) For greatest accuracy, always select the range which permits you to obtain a reading nearest full scale deflection without having the pointer go off scale. It is important to remember that 1500 volts is the highest RMS AC voltage that can be measured with your VTVM. The scales of the meter are calibrated to read both RMS and peak-to-peak voltages. Read the RMS values on the black scales marked "DC-RMS" and the peak-to-peak values on the red scales marked "P-P". Peak-to-peak voltages are equal to 2.83 times the RMS values of sine-wave voltages and the scales are so calibrated that when a voltage of 10 volts RMS for example is applied to the instrument, the meter pointer will indicate 10 volts on the 0-15 volt scale, and 28.3 volts on the 0-40 P-P red scale. Use the scale marked "1.5V RMS low AC" and "0-5.0V RMS low AC" for AC voltages that fall within these ranges.

See the charts below, indicating scales to be used.

AC RMS VOLTAGE MEASUREMENTS: Set Function Switch to "AC", and Switch in the probe to "AC-OHMS".

RMS VOLTAGE TO BE MEASURED	SET RANGE SWITCH TO	READ FROM SCALE	MULTIPLY READING BY
0 to 1.5V	1.5V	1.5 RMS, LOW AC	1
1.5 to 5V	5V	5 RMS, LOW AC	1
5 to 15V	15V	1.5 DC or RMS	10
15 to 50V	50V	5 DC or RMS	10
50 to 150V	150V	1.5 DC or RMS	100
150 to 500V	500V	5 DC or RMS	100
500 to 1500V	1500V	1.5 DC or RMS	1000

AC PEAK-TO-PEAK VOLTAGE MEASUREMENTS: Set Function Switch to "AC", and Switch in the probe to "AC-OHMS".

PEAK-TO-PEAK VOLTAGE TO BE MEASURED	READINGS IN RED COLOR		MULTIPLY READING BY
	SET RANGE SWITCH TO	READ FROM SCALE	
0 to 4V	4V	4 P-P, LOW AC	1
4 to 14V	14V	14 P-P, LOW AC	1
14 to 40V	40V	40 P-P	1
40 to 140V	140V	140 P-P	1
140 to 400V	400V	40 P-P	10
400 to 1400V	1400V	140 P-P	10
1400 to 4200V	4000V	40 P-P	100

Note that the "DC or RMS" scales are correct for AC voltages only when sine-wave voltages are being measured. The peak-to-peak scales can be used for both peak-to-peak of sine and non-sine (complex) voltages such as are measured in TV receivers

This VTVM is a highly sensitive electronic AC voltmeter, and since the human body and long unshielded test leads pick up AC voltage radiations when near any sources of such radiation such as power lines, the meter may indicate this pickup, and consequently reduce the accuracy of the voltage measurement. Therefore for utmost accuracy when measuring low voltages in high impedance circuits the user should avoid holding the test probe in his hand. A good practice is to use an alligator clip or wire hook of some kind on the end of the probe tip to clip to the voltage point, so that the hands may be removed entirely from the probe while reading the test voltage.

RESISTANCE MEASUREMENTS

To measure resistance with the VTVM, set the function switch to the "OHMS" position, and the range switch to a position that will result in the meter pointer reading as near to midscale as possible. Set the AC-OHMS DC switch on the test probe to the "AC-OHMS" position, then attach the common alligator clip to the probe tip and set the meter pointer to ZERO on the ohms scale by rotating the "ZERO" control. Then disconnect the alligator clip from the probe tip and use the "OHMS ADJ." control to set the pointer to exactly full scale, marked "∞" (infinity). Connect the common test lead alligator clip to one side of the resistance to be measured, and the probe tip to the other side. Read the resistance on the ohms scale, and multiply the proper factor for the range being used.

Set Function Switch to "OHMS" position, and Switch in the probe to "AC-OHMS".

RESISTANCE TO BE MEASURED	SET RANGE SWITCH TO	READ FROM SCALE	MULTIPLY READING BY
.2 to 1000 Ω	R x 1	R	1
1000 to 10000 Ω	R x 10	R	10
10000 to 100000 Ω	R x 100	R	100
100000 Ω to 1 Meg	R x 1000	R	1000
1 Meg to 10 Meg	R x 10 K	R	10,000
10 Meg to 100 Meg	R x 100 K	R	100,000
100 Meg to 1000 Meg	R x 1 Meg	R	1,000,000

READING THE METER SCALE

The needle should be set to mechanical zero when the instrument is turned off. This is accomplished (if necessary) by using the screwdriver adjustment to zero set the pointer.

The voltage markings on the RANGE switch indicate the corresponding *full scale* reading on the corresponding meter scale.

The low voltage AC scales, 0-1.5 RMS, 0-5 RMS, and 4 P-P, 14 P-P are set apart from the other AC voltage scales and separately calibrated to give more accurate readings. The diode rectifiers within the instrument inherently have a portion of their characteristics in a non-linear region. When rectifying low AC voltages, those non-linearities become prominent in the metering circuit and would lead to inaccuracies if the meter scale were not properly calibrated to account for them and to make suitable correction.

This does not apply to the DC scales, since in measuring DC, no rectifiers are used.

The colored Range Switch positions and their corresponding scales on the meter face are colored just to remind you that they indicate peak-to-peak AC voltage measurements.

RMS is an abbreviation of "Root Mean Square" which is a term relating to a sinewave of voltage and its effective or heating value, relating it to an equivalent DC (direct current) voltage. P-P is an abbreviation of "Peak-to-peak", or the total of the positive-going and negative-going voltages relative to a zero voltage axis.

When we are measuring a sinewave of voltage, there is a fixed mathematical relationship between RMS, Peak, and Peak-to-Peak:

Peak is 1.41 times RMS.

Peak-to-Peak is 2 times peak.

Peak-to-Peak is 2.83 times RMS.

RMS is .707 times peak.

RMS is .353 times peak-to-peak.

This relationship is valid, only when we are dealing with a sine-wave voltage. Since there are almost an infinite number of waveforms other than sinewave it is impossible within the scope of this manual to make any statement of relationship between RMS and peak-to-peak when dealing with other than sinewaves; each such complex waveform would have to be analyzed and a proper relationship established.

USING THE DECIBEL (Db) SCALE

The human ear responds in a logarithmic manner to variations in sound intensity and not linearly—that is when the amount of sound is doubled, the ear responds to it so that we sense only a slight increase in loudness rather than a doubled increase. A unit of loudness measure based on logarithms called the "bel" was adopted. The bel corresponds very nearly to the human ear response variations. Normally, loudness signal levels are given in tenths of a bel, or decibels, because this unit represents the smallest variation in sound intensity the ear can detect. Manufacturers use a variety of signal levels as a standard for zero db. The Db scale uses .001 watt (1 milliwatt) *into a 600 ohm* line as zero db. This corresponds to 0.775 volt AC on the 0-5 volt scale.

The decibel represents a voltage ratio, and it may be used without specifying the reference level. For example, a response curve may be plotted for an amplifier by injecting a signal of variable frequency and constant amplitude, with the VTVM connected to the output. Adjust the signal input at some reference frequency, such as 400 cycles, for a convenient indication on the VTVM. (Zero db for example.) As the input frequency is varied, the output variation may be observed in db above and below the reference frequency level.

CONVERSION CHART FOR RMS—P-T-P and DB (Decibel) SCALES.

FUNCTION SWITCH SETTING TO AC VOLTS		DB TO BE ADDED TO THE DB SCALE READING
RMS FULL SCALE, VOLTS	PEAK TO PEAK FULL SCALE, VOLTS	
1.5	4	—
5	14	Read db directly
15	40	10
50	140	20
150	400	30
500	1400	40
1500	4000	50

When using other than a 600 Ω load, a correction must be applied, to obtain true db values. The chart below indicates some typically used loads, and the correction which must be applied. A generalized equation for finding the correction is:

$$\text{db correction} = 10 \log_{10} \frac{600}{R}$$

Where R is the load in ohms. If R is greater than 600 ohms, the factor becomes negative, and must be subtracted from the db reading. If R is less than 600 ohms, the correction is added to the db reading.

LOAD, OHMS	ADD TO (+) OR SUBTRACT FROM (—) DB READING
9600	—15
4800	—12
2400	—6
1200	—3
600	0
500	+0.8
300	+3
250	+3.8
150	+6
50	+10.8
15	+16
8	+18.8
3.2	+22.7

CIRCUIT DESCRIPTION

The 100 microampere meter movement is connected in the plate circuit of a 12AU7 twin triode in a balanced bridge arrangement. The zero adjust control sets up a balance between the two triodes so that with zero voltage applied to the first grid, the potentials on each plate are equal. There will be no voltage drop or difference in potential across the meter, and consequently the meter will read zero. With a voltage applied to the first grid, the balanced condition is upset causing a difference in the potentials on the two plates and consequently across the meter. The meter will then indicate. The relationship between the test voltage applied to the first grid and the current through the meter is linear and therefore the meter is calibrated with a linear scale. One of the advantages of a vacuum tube voltmeter circuit is the voltages to be measured are applied to the tube and not directly to the meter. Since the amount of current a vacuum tube can draw is limited, the meter movement is electronically protected.

The maximum test voltage which is applied directly to the 12AU7 is approximately 1.5 volts. A voltage divider network having a total resistance of 10 megohms reduces voltages higher than 1.5 volts. An additional isolating resistance of 1 megohm, located in the test probe, is used in the DC position, making it possible to take measurements in circuits with R-F components with a minimum disturbance.

AC measurements: D3 and D4 are used to rectify the test voltages providing a DC voltage proportional to the applied AC. The DC voltages is then applied through the voltage divider network to the input grid of the 12AU7 balanced bridge circuit causing the meter to indicate. The AC voltage scales are calibrated to read both RMS and Peak-to-Peak values. The 0-1.5v and 0-5.0V RMS low AC scales have been especially calibrated to improve the accuracy of the meter on these low ranges. Stray pickup reduces the accuracy of any highly sensitive VTVM on the lower AC ranges. With this special scale you have improved accuracy that many other instruments do not have. In the 0-1.5, 0-50, and 0-150 volt ranges, the full AC voltage being measured is applied to the diode rectifier. A voltage divider network reduces the voltage on the 0-500, and 0-1500 voltage ranges to limit the voltage applied to the diode to a safe level. When the instrument is used properly, it is not possible to apply more than 150 volts to the diode. When measuring any unknown voltage, always make it a habit to start on the highest range, and then switch down to a more appropriate range.

For measuring resistances, a 1.5 volt DC supply is connected through a series of multiplier resistances and the external resistance to be measured. This forms a voltage divider circuit consisting of the 1.5 volt supply in series with one or more multiplier resistors and the resistance under test. The voltage across the unknown resistor is then proportional to its resistance This voltage is supplied to the input grid of the 12AU7 balanced bridge circuit which produces an ohmmeter scale reading proportional to the unknown resistance.

In the "off" position the meter movement is automatically shorted to prevent damage in transit.

MAINTENANCE SUGGESTIONS

Your VTVM is capable of continuous daily service requirements over a period of several years. In order for the user to fully realize these capabilities, the same degree of care in operation and maintenance should be accorded your instrument that would be given any fine piece of equipment.

SERVICE WARNINGS

- The following instructions are for use by qualified personnel only. To avoid electric shock, do not perform servicing other than contained in the operating instructions unless you are qualified to do so.
- A shock hazard is present when the case is removed and the unit is operating. Line voltage (120 VAC) may be present on the input power cord, on-off switch, power transformer, etc. any time the unit is connected to ac power, even if the switch is off.
- Disconnect the test leads from external devices and from the meter before servicing.

This B & K-PRECISION Model 177 VTVM is equipped with a *fused* ohms protection circuit. A 1 amp pigtail fuse is connected internally between the *common* test lead and chassis ground. The fuse may blow if the meter is connected to the 120 VAC power line or other high AC voltages while on the ohms functions. If the *ohms* protection fuse is open, all functions of the VTVM are affected since the fuse is in series with the *common* test lead. Test for open fuse by measuring continuity between the *common* test lead and the VTVM chassis using a separate ohm-meter. Replace with 1A 3AG fast blow only. The fuse connects directly from the common jack to the VTVM chassis.

Should failure of the meter movement coil be suspected, the continuity may be checked with another ohmmeter if you first connect a 10K OHM limiting resistor in series with the ohmmeter test leads. Remember: — NEVER test meter coil continuity directly with another ohmmeter without using a limiting resistance.

Do not attempt self-repair of the meter movement. This will automatically void our standard warranty on the VTVM.

The plastic meter cover may through repeated polishing or cleaning accumulate charges of static electricity. This will cause erratic pointer deflection whether the instrument is on or off. These static charges may easily be removed by using one of the commercially available anti-static solutions, or a solution of any good liquid dish washing detergent and water. Dip a clean, soft cloth in the solution and wipe the surface of the meter cover. The cover need not be removed for this operation.

Faulty operation of your VTVM may be caused by open or shorted test leads. Check the continuity and resistance periodically.

Another frequent source of trouble arises from accidental improper usage of the VTVM, resulting in failure of one or more precision resistors in the multiplier strings. Symptoms of this difficulty may be slow, upscale drifting of the pointer, inability to obtain proper zero adjust action, and of course incorrect voltage or resistance readings. Keep in mind that patience and the exercise of proper precautionary measures in the use of your instrument are of the utmost importance in keeping troubles of this type at a minimum.

IN ALL CASES WHERE FAULTY OPERATION OF THE INSTRUMENT IS SUSPECTED, THE SERVICE DEPARTMENT OF DYNASCAN CORP. SHOULD FIRST BE CONSULTED. SHOULD THE SERVICE DEPARTMENT RECOMMEND RETURN OF THE INSTRUMENT TO THE FACTORY, THE COMPLETE INSTRUMENT SHOULD BE CAREFULLY PACKED IN A WELL PADDED, STRONG CORRUGATED SHIPPING CARTON AND ADDRESSED TO DYNASCAN'S SERVICE DEPARTMENT.

IMPORTANT NOTE: The original packing of the unit is admirably suited for this purpose.

IMPORTANT: If at any time this meter is to be returned to the factory for repair, a COMPLETE description of suspected faulty operation, as noted by the operator, MUST accompany the instrument. The more details submitted to the Service Department of Dynascan Corp., the more quickly and efficiently the instrument can be repaired and returned. It is very important that this description of suspected faulty operation be given in unusually exact detail due to the fact that in many cases, faulty operation can be traced to difficulties in other items of test equipment and/or improper analysis of results obtained.

ANY WRITTEN INQUIRIES TO THE FACTORY REGARDING YOUR METER MUST INCLUDE COMPLETE SERIAL NUMBER OF YOUR INSTRUMENT. IF YOU NEGLECT TO INCLUDE THE SERIAL NUMBER, IT WILL BE NECESSARY FOR THE FACTORY TO REQUEST THE NUMBER IN ORDER TO ANALYZE YOUR PROBLEM.

Your meter is a relatively critical and delicate instrument. Do not attempt any major repairs before consulting the Service Department of Dynascan Corporation.

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the MAINTENANCE section of your B & K-Precision instruction manual for adjustments that may be applicable.

2. If the above-mentioned procedures do not correct the problem you are experiencing with your unit, pack it securely (preferably in the original carton or double-packed). Enclose a letter describing the problem and include your name and address. Deliver to, or ship PREPAID (UPS preferred) to the nearest B & K-Precision authorized service agency (see list enclosed with unit).

If your list of authorized B & K-Precision service agencies has been misplaced, contact your local distributor for the name of your nearest service agency, or write to:

Service Department

B & K-Precision Product Group
DYNASCAN CORPORATION
6460 West Cortland Street
Chicago, Illinois 60635

LIMITED ONE-YEAR WARRANTY

DYNASCAN CORPORATION warrants to the original purchaser that its B & K-PRECISION product, and the component parts thereof, will be free from defects in workmanship and materials for a period of one year from the date of purchase.

DYNASCAN will, without charge, repair or replace, at its option, defective product or component parts upon delivery to an authorized B & K-PRECISION service contractor or the factory service department, accompanied by proof of the date of purchase in the form of a sales receipt.

To obtain warranty coverage, this product must be registered by completing and mailing the enclosed warranty registration card to DYNASCAN, B & K-PRECISION, 6460 W. Cortland St., Chicago, Illinois 60635 within fifteen (15) days from the date of purchase.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. It is void if the serial number is altered, defaced or removed.

DYNASCAN shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may also have other rights which vary from state to state.

For your convenience we suggest you contact your B & K-PRECISION distributor, who may be authorized to make repairs or can refer you to the nearest service contractor. If warranty service cannot be obtained locally, please send the unit to B & K-PRECISION Service Department, 6460 West Cortland Street, Chicago, Illinois 60635, properly packaged to avoid damage in shipment.

B+K PRECISION DYNASCAN CORPORATION

6460 West Cortland Street
Chicago, Illinois 60635

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480-086-9-001J

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SCHEMATIC DIAGRAM
AND
PARTS LIST

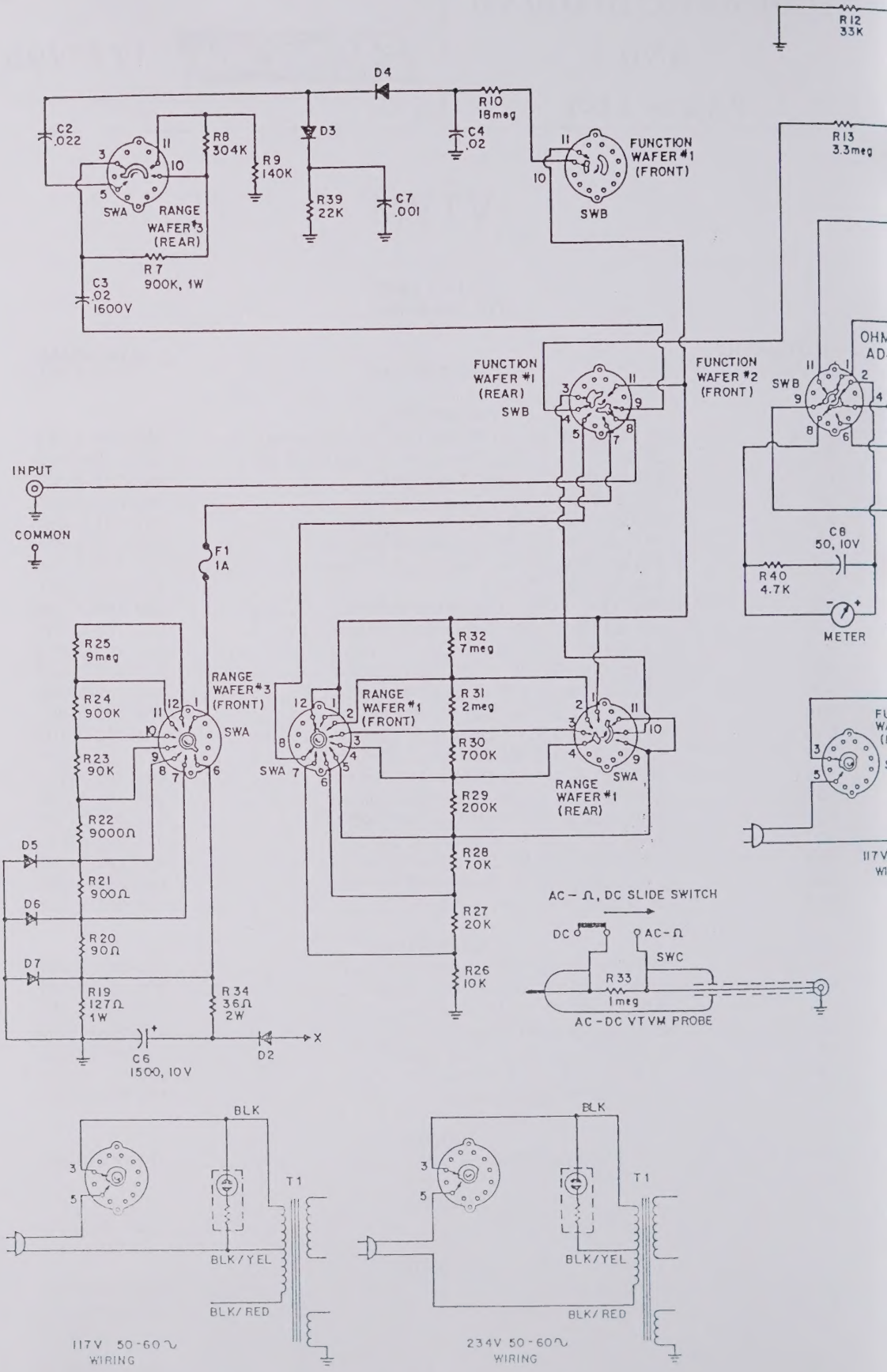
B&K PRECISION 177/V95

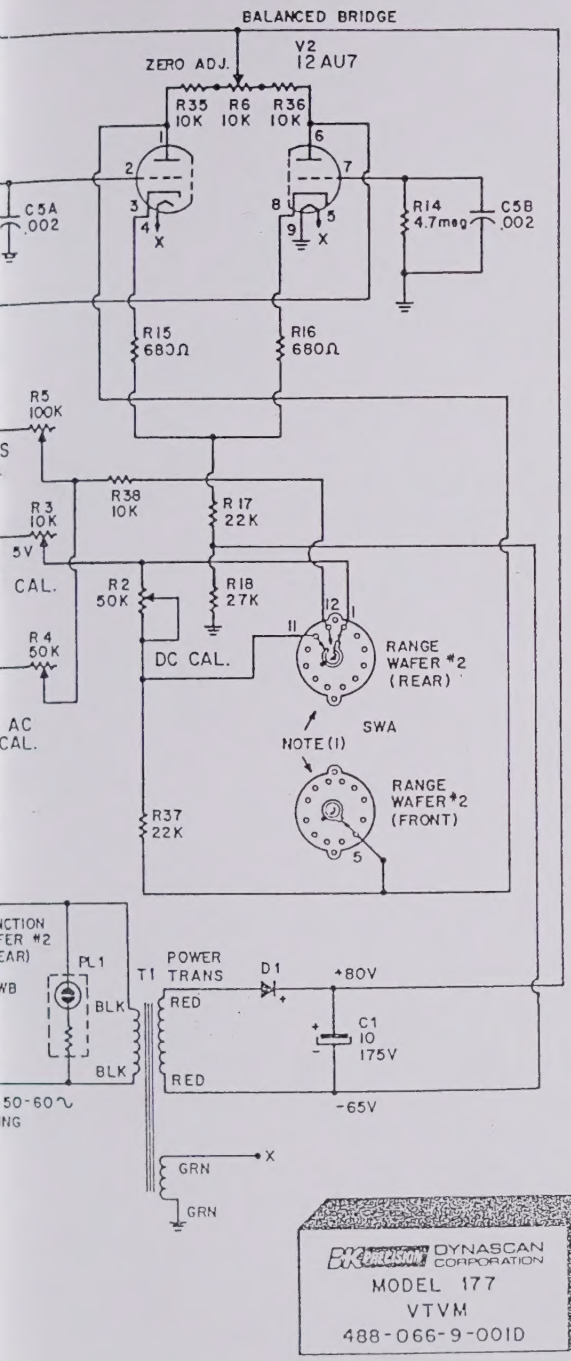
VTVM

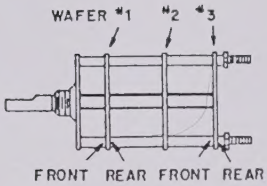
PARTS LIST
488-066-9-002G

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
	RESISTORS	
R2, 4	50 kΩ ±20%, Linear Taper Pot. (Twist Prong)	008-060-9-003
R3	10 kΩ ±20%, Linear Taper Pot. (Twist Prong)	008-060-9-002
R5	100 kΩ ±20%, Linear Taper Pot.	008-001-9-030
R6	10 kΩ ±20%, Linear Taper Pot.	008-001-9-029
R7	900 kΩ ±1%, 1 W, Deposited Carbon	002-001-3-904
R8	304 kΩ ±1%, 1/2 W, Deposited Carbon	004-076-9-001
R9	140 kΩ ±1%, 1/2 W, Deposited Carbon	002-102-3-144
R19	12.7 Ω ±1%, 1/2 W	004-074-9-001
R20	90 Ω ±1%, 1/2 W, Deposited Carbon	002-102-3-900
R21	900 Ω ±1%, 1/2 W, Deposited Carbon	002-102-3-901
R22	9 kΩ ±1%, 1/2 W, Deposited Carbon	002-102-3-902
R23	90 kΩ ±1%, 1/2 W, Deposited Carbon	002-102-3-903
R24	900 kΩ ±1%, 1/2 W, Deposited Carbon	002-102-3-904
R25	9 MΩ ±1%, 1/2 W, Deposited Carbon	002-102-3-905
R26	10 kΩ ±1%, 1/2 W, Deposited Carbon	002-102-3-103
R27	20 kΩ ±1%, 1/2 W, Deposited Carbon	002-102-3-203
R28	70 kΩ ±1%, 1/2 W, Deposited Carbon	002-102-3-703
R29	200 kΩ ±1%, 1/2 W, Deposited Carbon	002-102-3-204
R30	700 kΩ ±1%, 1/2 W, Deposited Carbon	002-102-3-704
R31	2 MΩ ±1%, 1/2 W, Deposited Carbon	002-102-3-205
R32	7 MΩ ±1%, 1/2 W, Deposited Carbon	002-102-3-705
R33	1 MΩ ±1%, 1/2 W, Deposited Carbon	002-102-3-105
R34	36 Ω ±5%, 2 W, Metal Film	004-075-9-001
	CAPACITORS	
C1	10 µF @ 175 V, Electrolytic	021-003-9-007
C2	0.022 µF ±10%, 400 V, Polyester	025-139-9-001
C3	0.02 µF ±20%, 1.6 kV, Tubular	026-162-7-203
C4	0.02 µF, Ceramic Disc	020-501-7-203
C5	0.002 ±20%, 500 V, Ceramic Disc	020-087-9-001
C6	1600 µF @ 10 V, Electrolytic	022-001-9-013
C8	50 µF, 10 V, Electrolytic	022-025-9-001
	DIODES	
D1 - 7	1 A, 600 PIV, Silicon	151-050-9-001
	TUBES	
V2	12AU7	232-120-1-217
	SWITCHES	
SWA	Range Switch	083-070-9-001
SWB	Function Switch	083-110-9-001

COMPOSITE
499-021-9-001E


R12
33K
D4
R10
18meg
C2
.022
R8
304K
D3
C4
.02
FUNCTION
WAFER #1
(FRONT)
R13
3.3meg
R9
140K
R39
22K
C7
.001
SWB
SWA
RANGE
WAFER #3
(REAR)
R7
900K, 1W
C3
.02
1600V
FUNCTION
WAFER #1
(REAR)
SWB
FUNCTION
WAFER #2
(FRONT)
SWB
INPUT
COMMON
F1
1A
C8
50, 10V
R40
4.7K
METER
R25
9meg
R24
900K
R23
90K
R22
9000Ω
RANGE
WAFER #3
(FRONT)
SWA
R32
7meg
R31
2meg
R30
700K
R29
200K
R28
70K
R27
20K
R26
10K
RANGE
WAFER #1
(FRONT)
SWA
RANGE
WAFER #1
(REAR)
SWA
D5
D6
D7
R21
900Ω
R20
90Ω
R19
127Ω
1W
R34
36Ω
2W
C6
1500, 10V
D2
X
AC – Ω, DC SLIDE SWITCH
DC
AC-Ω
SWC
R33
1meg
AC-DC VTVM PROBE
BLK
T1
BLK/YEL
BLK/RED
117V 50-60~
WIRING
BLK
T1
BLK/YEL
BLK/RED
234V 50-60~
WIRING





RANGE SWITCH SHOWN IN .5V - DC POSITION

SWITCH SEQUENCE:

.5V - DC
1.5V - Rx1
5V - Rx10
15V - Rx100
50V - Rx100
150V - Rx10000
500V - Rx100K
1500V - Rx1meg

FUNCTION SWITCH SHOWN IN "OFF" POSITION

SWITCH SEQUENCE OFF/TRANSIT

AC
-DC
+DC
OHMS

UNLESS OTHERWISE NOTED:

SWITCHES LABELED "FRONT" VIEWED FROM KNOB END.

SWITCHES LABELED "REAR" VIEWED FROM REAR

K = 1000

MEG = 1,000,000

ALL CAPACITORS IN μF

LAST "R" NO. — 40

LAST "C" NO. — 8

NOTES:

(1) RANGE SWITCH FRONT & REAR WAFERS VIEWED FROM KNOB END. FRONT & REAR ROTORS ARE SOLDERED.

DYNASCAN CORPORATION

MODEL 177

VTVM

488-066-9-001D

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.

MISCELLANEOUS

117 V, 60 Hz Transformer	065-041-9-001
117 - 234 V, 50 - 60 Hz Transformer	065-041-9-002
Meter	523-059-9-001
AC/DC Probe Assembly	PR-43
Neon With 100 kΩ Resistor	401-001-9-002
Line Cord	420-034-9-001
Black Test Lead Assembly	539-002-0-000
Knob w/Indicator Line	751-213-9-001
Knob, Plastic	751-064-9-003
Fuse, 1 A, 3 AG, Pigtail	193-020-9-001
Instruction Manual	480-086-9-001

OPTIONAL ACCESSORIES:

AV-1A	R.F. Probe extends range to 250 MHz
AV-2A	High Voltage Probe

PARTS ORDERING INFORMATION

There is a minimum charge for each invoice. Orders will be shipped C.O.D. unless previous open account arrangements have been made or remittance accompanies order. Advance remittance must cover handling, postage, or express charges. Specify model and serial number when ordering replacement parts.

ORDER REPLACEMENT PARTS FROM:

B & K-Precision, Dynascan Corporation
Factory Service Operations
4050 North Ravenswood Avenue
Chicago, Illinois 60613

B&K PRECISION DYNASCAN CORPORATION

6460 West Cortland Street
Chicago, Illinois 60635

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